Current Trends in Natural Sciences Vol. 8, Issue 15, pp. 209-215, 2019

Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521

Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

HUMAN INFLUENCE ON THE CLIMATE SYSTEM

Aurelia Nica [1*], Adina Popescu [1], Daniela-Cristina Ibanescu [1]

[1] "Dunarea de Jos" University of Galati, Faculty of Food Science and Engineering, S.A.I.A.B.A. Department, Galați, Romania

Abstract
Climate either from the earth as a whole or in one country or location is often described as the weather recorded over a long period. It is defined in terms of long-term averages and other weather statistics, including frequencies of extreme events. The climate is far from static. As the weather changes daily, the climate changes, over a period of several years, decades, and millennia and longer, corresponding to the geological history of the earth. These changes, caused by internal and external factors for the climate system, are naturally intrinsic to the climate itself. However, not all climate change is caused by natural processes. People also exercised influence. By building cities and changing land use patterns, people have changed the climate on a local scale. Through a series of industrial-era activities in the mid-19th century, such as the accelerated use of fossil fuels and land deforestation that changes, people have also contributed to the greenhouse effect. This increased greenhouse effect leads to an increase in atmospheric concentrations of greenhouse gases, such as carbon dioxide and methane, and is generally considered responsible for the observed increase in global average temperatures.

Keywords: climate, weather, global warming, human influence

1. INTRODUCTION TO THE CLIMATE SYSTEM

The surface of the earth is the intersection of distinct parts of the climate system. Understanding the different parts or components of the climate system is critical for modeling (or simulating) the system (Gettelman and Rood, 2016). The climatic system is constituted by four intimately interconnected sub-systems, atmosphere, hydrosphere, cryosphere, and biosphere, which evolve under the action of macroscopic driving and modulating agents, such as solar heating, Earth's rotation and gravitation (Lucarini, 2010).

Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems (Climate Change, 2014). The Sun warms the Earth, but the process by which this happens is fairly complicated. On average, over the 24 hours of the day and the four seasons of the year, 343 watts/square meter (about 285 watts/square yard) of solar energy shine down on the top of the Earth's atmosphere. About a third of this energy never reaches the Earth's surface; it is reflected by clouds and particles in the atmosphere. Another sixth is reflected by the Earth's surface. The remaining half is absorbed by the Earth. However, even this simplified view of the climate system indicates three ways in which humans can affect climate (Bernstein, 2007):

1. We can increase the amount of greenhouse gas in the atmosphere, which will lead to warming.

*Corresponding author, E-mail address: anica@ugal.ro

Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521

Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

2. We can increase the amount of particulate (dust, soot, sulfate particles, etc.) in the atmosphere, which will generally lead to cooling.
3. We can change the Earth's surface, for example, by clearing forests to plant crops, which will change the amount of the Sun's energy that the Earth reflects, and could lead to either warming or cooling.

Man is adaptable by excellence, but we imagine that a human being will come to breathe hydrogen sulfide and carbon dioxide, to drink cyanide and oil, to live through the heap of solid waste, it is nonsense of course, result in a simplistic extrapolation of current trends. Such situations pushed to extremes can only lead to human destruction and not adaptation. The human impact is difficult to assess reliably because it results from a complex interplay of factors. It is challenging to isolate the human impact of climate change definitively from other factors such as natural variability, population growth, land use and governance (Global Humaritarian Forum, 2009).

2. CAUSES OF INCREASE GREENHOUSE GAS IN THE ATMOSPHERE

2.1. Anthropogenic sources of greenhouse gases

There is very strong evidence to indicate that climate change has occurred on a wide range of different timescales from decades to many millions of years; human activity is a relatively recent addition to the list of potential causes of climate change (The Royal Society, 2010). More than a hundred years after the first scientific explanation of Earth's natural greenhouse effect and sixty years since Swedish scientist Svante Arrhenius first calculated the additional heating that could be expected from the rise in carbon dioxide Atmosphere (1895), distinguished oceanographer and meteorologist Roger Revelle drew attention to issues such as oil and coal burning, resources that have been accumulated over millions of years, burning them with serious consequences on the climate. The concerns of Revelle and others were instrumental in initiating, in 1957, what was the most important geophysical record ever established: permanent monitoring of the atmospheric concentration of carbon dioxide in the atmosphere at the top of Mauna Loa, Hawaii.

Current levels of human consumption, in combination with growing population, are having a significant negative impact on the natural environment and are contributing to climate change. Industrial pollution is the release of waste and pollutants generated by industrial activities into natural environments, including air, water and land. In addition, industrial pollution is linked to the degradation of the natural environment. Industrial pollution influences the environment in many ways and has serious consequences on human life and health. At the same time, industrial pollution can damage plants, kill animals, cause ecosystem imbalances and degrade quality of life. Major industries, such as power stations, steel factories, wastewater treatment plants, thermal power plants and glass melting, among other production, processing and manufacturing companies, contribute to industrial pollution.

They release the smoke, effluents, waste materials, toxic products, contaminated waste, and consumer chemicals, which eventually end up in the environment, causing pollution.

Here is a list of the main causes of industrial pollution.

2.1.1. Toxic chemicals

Toxic chemicals used by industries in processing and production are the largest contributors to industrial pollution. These substances pose a threat to a qualitative life and are dangerous to human health and the environment. Industrial plants around the world generate over 25 million tons of toxic chemicals as waste and pollutants from production. These toxic chemical pollutants are released into the environment, leading to various forms of pollution.

2.1.2. Emissions of greenhouse gases

*Corresponding author, E-mail address: anica@ugal.ro

Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521

Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

2.1.2.1. Carbon dioxide (CO_2) is well known as a greenhouse gas because of its ability to absorb thermal radiation that causes global warming and climate change. The use of industrial energy during production generates large emissions of carbon dioxide gas into the atmosphere, making it a major source of CO_2 emissions. CO_2 emissions from around the world come from the combined use of energy consumption in the commercial, production, processing and energy industries. Although carbon dioxide emissions from industrial industries have declined over the last decade, industries remain a major contributor to the contribution of CO_2 and other greenhouse gases to the atmosphere (http://www.eartheclipse.com/pollution/primary-causes-of-industrial-pollution.html).

2.1.2.2. Oil and coal

The overwhelming majority of climate scientists agree that human activities, especially the burning of fossil fuels (coal, oil and gas), are responsible for most of the climate change currently being observed (National Research Council, 2012). Both coal and oil produce great environmental damage and, especially because of its carbon dioxide anhydride, they are responsible for the greenhouse effect. Today, industrialized countries cannot miss oil and coal, but some countries are making great efforts to use clean energy sources. Otherwise, the future of the entire planet is jeopardized.

As coal is polluting more than any other fuel, we consider the promotion of coal-fired power plants in China, India and even in Russia, even though they also develop nuclear power.

2.1.2.3. Methane

Methane gas is seen by many as an alternative to coal and oil, however, and methane gas is very polluting, even if it is 60% sustained, compared to coal, even taking into account the cost of this raw material and of the great dependence created by its import. Methane is a non-renewable resource. The use of methane gas may be shorter as consumption increases. On the other hand, methane has more important uses than massive energy production, and is often irreplaceable, for example in chemistry (Barnea and Papadopol, 1975).

2.2. Urban climate change

"The Urban Heat Island" (UHI) refers to the observation that cities tend to be warmer than their rural surroundings because of the physical differences between urban and natural landscapes. Concrete and asphalt of the urban environment tend to reduce the reflectivity of the city compared to the natural environment. This increases the amount of solar radiation absorbed to the surface. Cities also tend to have fewer trees than rural surroundings, and therefore shadows and evapotranspiration are reduced. Cooling effects of the wind can also be reduced by the city's buildings. UHI is enhanced by human activities within the urban environment. Pollution has the effect of warming up a city, in addition to the heat released by industrial processes, domestic heating and the use of cars. As the cities grow, the UHI effect becomes stronger, creating an artificial heating trend in temperature recording. The historical temperature recorded in Melbourne shows rapid growth over the 1950s, at least partly due to increased urbanization and the use of cars. UHI is the most visible when it is clear, quiet at night when rural areas are effectively capable of radiating the heat gained during the day back into space, while the urban environment retains a higher proportion of heat. Depending on the weather conditions, overnight temperatures in the center of a large city may be up to 10 ° C higher than the rural surroundings. The urban landscape also has other effects on the local climate such as the average wind speed due to the blocking effect of buildings and a higher frequency of flooding due to the higher proportion of asphalt that reduces natural drainage (Houghton, 1997).

*Corresponding author, E-mail address: anica@ugal.ro

Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521

Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

2.3. Nuclear winter

One of the greatest potential impacts on the future of the climate is the threat, which is currently believed to be very possible, by a nuclear winter resulting from the enormous increase in smoke and dust in the atmosphere caused by a nuclear holocaust. A nuclear war may have the most sudden and disastrous impact on the climate and humanity is currently technologically capable of producing such a disaster.

A similar and equally catastrophic effect could be the collision of the earth with a major asteroid or a comet. Over the last two decades, evidence of continued carbon dioxide and other greenhouse gas emissions because of human activities has become conclusive. These changes have come as a combined effect of increasing emissions from burning fossil fuels and more and more frequent deforestation.

2.4. Means of transport

The transport is divided into different categories of means of transport: rail, naval, air and road. Road transport is now considered but also the most important pollutant of air in the future. Although it is well known that cars are polluting, their number is steadily increasing. High-quality fuel consumed by airplanes causes less disturbing pollution than road-borne pollution, but the explosive growth of air transport has led to excessive pollution, as well as the location of airports in urban areas affecting the human population. Airplanes are currently flying at high altitude, some even in the stratosphere, where pollutants are more difficult to spread due to slower weather changes. Burning fossil fuels to drive our cars leads to CO2 emissions, which is the main cause of global warming. The United States is the world's largest producer of harmful gases. Burned fuel can also produce toxic substances such as sulfur dioxide and carbon monoxide (which may be fatal). Diesel vehicles are the worst offenders, responsible for 79% of the pollution (http://science.howstuffworks.com/environmental/energy/transportation-air-pollution.htm).

3. HUMAN –INDUCED CLIMATE VARIATIONS

3.1. Human influence on the Climate System

Human beings, like other living organisms, have always influenced their environment. It is only since the beginning of the Industrial Revolution, mid-18th century that the impact of human activities has begun to extend to a much larger scale, continental or even global. Human activities, in particular those involving the combustion of fossil fuels for industrial or domestic usage, and biomass burning, produce greenhouse gases and aerosols which affect the composition of the atmosphere. The emission of chlorofluorocarbons (CFCs) and other chlorine and bromine compounds has not only an impact on the radiative forcing, but has also led to the depletion of the stratospheric ozone layer. Land-use change, due to urbanisation and human forestry and agricultural practices, affect the physical and biological properties of the Earth’s surface. Such effects change the radiative forcing and have a potential impact on regional and global climate (https://www.ipcc.ch/ipccreports/tar/wg1/044.htm).

3.2. Climate response

The increase in greenhouse gas and aerosol concentrations in the atmosphere and also land-use change produces a radiative forcing or affects processes and feedbacks in the climate system. The response of the climate to these human-induced forcings is complicated by such feedbacks, by the strong non-linearity of many processes and by the fact that the various coupled components of the climate system have very different response times to perturbations. Qualitatively, an increase of

*Corresponding author, E-mail address: anica@ugal.ro

Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521

Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

atmospheric greenhouse gas concentrations leads to an average increase of the temperature of the surface-troposphere system. The response of the stratosphere is entirely different. The stratosphere is characterized by a radiative balance between absorption of solar radiation, mainly by ozone, and emission of infrared radiation mainly by carbon dioxide. An increase in the carbon dioxide concentration therefore leads to an increase of the emission and thus to a cooling of the stratosphere.

The only means available to quantify the non-linear climate response is by using numerical models of the climate system based on well-established physical, chemical and biological principles, possibly combined with empirical and statistical methods. 97 percent of climate scientists are certain that human-caused climate change is occurring (www.learner.org).

In some sectors and for some regions human-induced climate change may not have as great an impact on natural resources as might multi-decadal natural climate variability.

Human activities have increased the atmospheric concentrations of other important greenhouse gases as well. Methane, which is produced by the burning of fossil fuels, the raising of livestock, the decay of landfill wastes, the production and transport of natural gas, and other activities, increased sharply through the 1980s before starting to level off at about two-and-a-half times its preindustrial level. Nitrous oxide has increased by roughly 15% since 1750, mainly as a result of agricultural fertilizer use, but also from fossil fuel burning and certain industrial processes. Certain industrial chemicals, such as chlorofluorocarbons (CFCs), act as potent greenhouse gases and are long-lived in the atmosphere. Because CFCs do not have natural sources, their increases can be attributed unambiguously to human activities (Hulme et al, 1999).

3.3. Human Impacts on Climate

People can address climate change in two ways. The first is to reduce greenhouse gas emissions in order to slow or reduce their build up in the atmosphere and reduce their warming effects. The second is to devise steps to help people cope with the potential impacts of climate change.

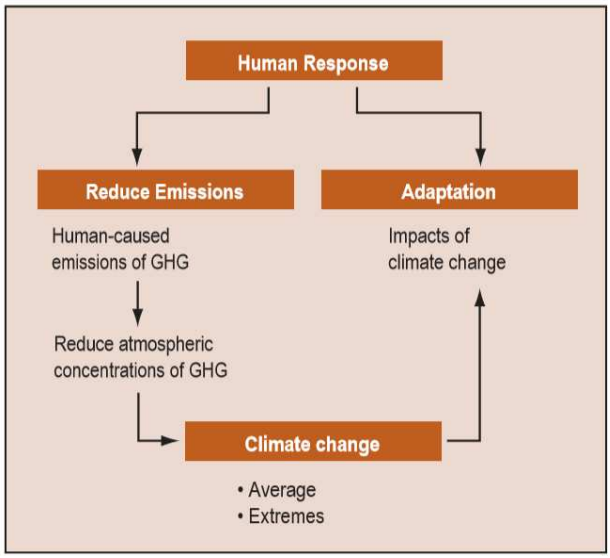

Fig. 1. The relationship between human-caused greenhouse gas (GHG) emissions and climate change impacts.

Human activities (especially biomass burning; agriculture; animal husbandry; fossil fuel extraction, distillation, and use; and the creation of landfills and rice paddies) have increased the

*Corresponding author, E-mail address: anica@ugal.ro

Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521

Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

atmospheric concentrations of several other greenhouse gases (methane, nitrous oxide, chlorofluorocarbons (CFCs)) and tropospheric ozone. These other greenhouse gases tend to reinforce the changes caused by increased CO_2 levels. However, the observed decreases in lower stratospheric ozone since the 1970s, caused principally by human-introduced CFCs and halocarbons, contribute a small cooling effect (Trenbert, 2001). The relative role of human versus natural influences became clearer in the early 2000s (Leggett, 2018).

In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans. Impacts are due to observed climate change, irrespective of its cause, indicating the sensitivity of natural and human systems to changing climate.

Evidence of observed climate change impacts is strongest and most comprehensive for natural systems. In many regions, changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources in terms of quantity and quality. Many terrestrial, freshwater and marine species have shifted their geographic ranges, seasonal activities, migration patterns, abundances and species interactions in response to ongoing climate change. Some impacts on human systems have also been attributed to climate change, with a major or minor contribution of climate change distinguishable from other influences. Assessment of many studies covering a wide range of regions and crops shows that negative impacts of climate change on crop yields have been more common than positive impacts. Some impacts of ocean acidification on marine organisms have been attributed to human influence (Impacts of climate change, 2014).

Humans are significantly altering the global climate, but in the variety of diverse ways beyond the radiative effect of CO_2. Significant, societally important climate change on the regional and local scales, due to both natural and human climate forcings, can occur due to these diverse influences. The result of the more complex interference of humans in the climate system is that attemps to significantly influence regional and local-scale climate based on controlling CO_2 emissions alone is an inadequate policy for this purpose. There is a need to minimize the human disturbance of the climate by limiting the amount of CO_2 that is emitted into the atmosphere by human activities, but the diversity of human climate forcings should not be ignored (Pielke Sr., 2008).

4. CONCLUSIONS

Humanity is the major influence on the global climate change observed over the past 50 years.Any changes in the mixture of atmospheric concentration and greenhouse gases, either natural or man-induced, will lead to changes in the radiation of the atmosphere and will therefore increase global warming. Global Climate Model calculations have established clear linkages between high greenhouse gas concentrations and large-scale surface heating and other climate change. It seems likely that throughout the 21st century, intensifying the radiation due to the growth of these gases will have a significant impact on the global climate. The scientific basis for predicting the increase in greenhouse effect is a simple concept. Increased concentrations of radiative gases alter the atmosphere and the climate. These aerosols result from both natural sources such as forest fires, desert winds and volcanic eruptions, but also from human causes such as burning fossil fuels, deforestation, and burning biomass. They can directly influence the radiation flow by absorbing and spreading solar radiation or indirectly by acting as the nuclei formed by raindrops from the clouds. This, in turn, influences the formation, lifetime and the radiation properties of the clouds. Concentrations of tropospheric aerosols vary greatly in space and time, and may have a heating or cooling effect based on their size, concentration, and vertical distribution.

*Corresponding author, E-mail address: anica@ugal.ro

Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521

Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

6. REFERENCES

Bernstein L. (2007). An Introduction to the Climate System and Climate Change. *Appalachian trail conservancy*.

Climate Change (2014). Synthesis Report, Summary for Policymakers.

Earth, Climate, and Change: Observing Human Impact from www.learner.org.

Global Humaritarian Forum (2009). Climate Change — The Anatomy of a Silent Crisis.

Gettelman, A., Rood R., (2016). *Components of the Climate System*., DOI: 10.1007/978-3-662-48959-8_2. In: *Demystifying Climate Models*.

Hulme M., Barrow E., Arnell N., Harrison A., Johns T. & Downing T. (1999). Relative impacts of human induced climate change and natural climate variability. In *Nature* (vol. 397, p. 688-691).

Houghton, John- Global Warming: The Complete Briefing. *Cambridge University Press* (251 pp. 1997).

Impacts of climate change. *Climate Change 2014 Synthesis Report, Summary for Policymakers.*

Leggett J., (2018). Evolving Assessments of Human and Natural Contributions to Climate Change, Congressional Research Service 7-5700 from www.crs.gov.

Lucarini V. Modelling Complexity: the case of Climate Science.

Matei Barnea and Corneliu Papadopol (1975). Poluarea si protectia mediului. [Pollution and environmental protection] Editura Stiintifica si Enciclopedica , Bucuresti.

National Research Council (2012). *Evidence, Impacts and Choices* from www.national-academies.org.

Roger A. Pielke Sr.- A broader view of the role of humans in the climate system, November 2008, Physics today, p. 54-56.

The Royal Society (2010). Climate change: a summary of the science.

Trenbert K. (2001). Stronger Evidence of human Influences on Climate. *The 2001 IPCC Assessment, Environment* (volume 43, number 4, p. 9-19).

https://www.ipcc.ch/ipccreports/tar/wg1/044.htm

http://www.eartheclipse.com/pollution/primary-causes-of-industrial-pollution.html

http://science.howstuffworks.com/environmental/energy/transportation-air-pollution.htm

*Corresponding author, E-mail address: anica@ugal.ro